General

Guideline Title

2011 ACCF/AHA guideline for the diagnosis and treatment of hypertrophic cardiomyopathy: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines.

Bibliographic Source(s)

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Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

Definitions for the weight of the evidence (A-C) and classes of recommendations (I-III) are provided at the end of the "Major Recommendations" field.

Diagnosis

Genetic Testing Strategies/Family Screening

Class I

1. Evaluation of familial inheritance and genetic counseling is recommended as part of the assessment of patients with hypertrophic cardiomyopathy (HCM) (Ho et al., 2002; Arad et al., 2005; Morita et al., 2008; Niimura et al., 1998; Van Driest et al., 2002; Van Driest et al., "Comprehensive," 2004). (Level of Evidence: B)
2. Patients who undergo genetic testing should also undergo counseling by someone knowledgeable in the genetics of cardiovascular disease so that results and their clinical signiﬁcance can be appropriately reviewed with the patient (Christiaans et al., "Genetic," 2009; Michie et al., 1997; Michie et al., 1998; Offﬁt et al., 2004; Christiaans et al., "Quality," 2009). (Level of Evidence: B)
3. Screening (clinical, with or without genetic testing) is recommended in ﬁrst-degree relatives of patients with HCM (Ho et al., 2002; Arad et al., 2005; Morita et al., 2008; Niimura et al., 1998; Van Driest et al., "Comprehensive," 2004; Fokstuen et al., 2008; Olivotto et al., 2008). (Level of Evidence: B)
4. Genetic testing for HCM and other genetic causes of unexplained cardiac hypertrophy is recommended in patients with an atypical clinical presentation of HCM or when another genetic condition is suspected to be the cause (Maron et al., 2001; Rosenzweig et al., 1991; Spada et al., 2006). (Level of Evidence: B)

Class IIa

1. Genetic testing is reasonable in the index patient to facilitate the identiﬁcation of ﬁrst-degree family members at risk for developing HCM (Ho et al., 2002; Van Driest et al., 2002; Fokstuen et al., 2008). (Level of Evidence: B)

Class IIb

1. The usefulness of genetic testing in the assessment of risk of sudden cardiac death (SCD) in HCM is uncertain (Moolman et al., 1997; Woo et al., 2003). (Level of Evidence: B)

Class III: NO BENEFIT

1. Genetic testing is not indicated in relatives when the index patient does not have a de¬nitive pathogenic mutation (Ho et al., 2002; Arad et al., 2005; Morita et al., 2008; Niimura et al., 1998; Van Driest et al., 2002; Van Driest et al., "Comprehensive," 2004; Ho et al., 2000). (Level of Evidence: B)
2. Ongoing clinical screening is not indicated in genotype-negative relatives in families with HCM (Ho et al., 2000; Ingles et al., 2005; Van Driest et al., "Myosin," 2004; Jeschke et al., 1998). (Level of Evidence: B)

Genotype-Positive/Phenotype-Negative Patients

Class I

1. In individuals with pathogenic mutations who do not express the HCM phenotype, it is recommended to perform serial electrocardiography (ECG), transthoracic echocardiography (TTE), and clinical assessment at periodic intervals (12 to 18 months in children and adolescents and about every 5 years in adults), based on the patient's age and change in clinical status (Christiaans et al., "Ventricular," 2009; Andersen et al., 2009; Christiaans et al., 2010; Michels et al., 2009). (Level of Evidence: B)

Electrocardiography

Class I

1. A 12-lead ECG is recommended in the initial evaluation of patients with HCM. (Level of Evidence: C)
2. Twenty-four hour ambulatory (Holter) electrocardiographic monitoring is recommended in the initial evaluation of patients with HCM to detect ventricular tachycardia (VT) and identify patients who may be candidates for implantable cardioverter-de¬brillator (ICD) therapy (Maron BJ et al., "American," 2003; Elliott et al., 2006; Maron et al., 1981; Monserrat et al., 2003). (Level of Evidence: B)
3. Twenty-four hour ambulatory (Holter) electrocardiographic monitoring or event recording is recommended in patients with HCM who develop palpitations or lightheadedness (Maron BJ et al., "American," 2003; Elliott et al., 2006; Maron et al., 1981). (Level of Evidence: B)
4. A repeat ECG is recommended for patients with HCM when there is worsening of symptoms. (Level of Evidence: C)
5. A 12-lead ECG is recommended every 12 to 18 months as a component of the screening algorithm for adolescent ¬rst-degree relatives of patients with HCM who have no evidence of hypertrophy on echocardiography. (Level of Evidence: C)
6. A 12-lead ECG is recommended as a component of the screening algorithm for ¬rst-degree relatives of patients with HCM. (Level of Evidence: C)

Class IIa

1. Twenty-four-hour ambulatory (Holter) electrocardiographic monitoring, repeated every 1 to 2 years, is reasonable in patients with HCM who have no previous evidence of VT to identify patients who may be candidates for ICD therapy (Monserrat et al., 2003). (Level of Evidence: C)
2. Annual 12-lead ECGs are reasonable in patients with known HCM who are clinically stable to evaluate for asymptomatic changes in conduction or rhythm (i.e., atrial fibrillation [AF]). (Level of Evidence: C)

Class IIb

1. Twenty-four-hour ambulatory (Holter) electrocardiographic monitoring might be considered in adults with HCM to assess for asymptomatic paroxysmal AF/atrial ¬,utter. (Level of Evidence: C)

Imaging

Echocardiography

Class I

1. A TTE is recommended in the initial evaluation of all patients with suspected HCM (Maron, 2002; Klues, Schiffers, & Maron, 1995; Wigle et al., 1985; Wigle et al., 1995; Adabag, Kuskowski, & Maron, 2006; Afonso, et al., 2008; Fifer & Vlahakes, 2008; Soor et al., 2009). (Level of Evidence: B)
2. A TTE is recommended as a component of the screening algorithm for family members of patients with HCM unless the family member is genotype negative in a family with known de¬nitive mutations (Bos, Towbin, & Ackerman, 2009; Maron, Seidman, & Seidman, 2004; Binder et al., 2006; Hershberger et al., 2009). (Level of Evidence: B)
3. Periodic (12 to 18 months) TTE screening is recommended for children of patients with HCM, starting by age 12 years or earlier if a growth spurt or signs of puberty are evident and/or when there are plans for engaging in intense competitive sports or there is a family history of SCD (Maron, Seidman, & Seidman, 2004; Schwartz et al., 1996). (Level of Evidence: C)
4. Repeat TTE is recommended for the evaluation of patients with HCM with a change in clinical status or new cardiovascular event (Harris et al., 2006; Maron MS et al., "Effect," 2003; Maron et al., "Epidemiology," 2000; Dimitrow & Dubiel, 2005; Efthimiadis et al., 2009; Ommen, Shah, & Tajik, 2008; Sorajja et al., 2009). (Level of Evidence: B)

5. A transesophageal echocardiogram (TEE) is recommended for the intraoperative guidance of surgical myectomy (Grigg et al., 1992; Marwick et al., 1992; Yu et al., 2000). (Level of Evidence: B)
6. TTE or TEE with intracoronary contrast injection of the candidate's septal perforator(s) is recommended for the intraprocedural guidance of alcohol septal ablation (Sorajja et al., 2008; Faber et al., 2004; Monakier et al., 2004; Nagueh et al., 1998). (Level of Evidence: B)
7. TTE should be used to evaluate the effects of surgical myectomy or alcohol septal ablation for obstructive HCM (Ommen et al., 2005; Sorajja et al., 2008; Carasso et al., 2008; Fernandes et al., 2008; Jassal et al., 2006; Woo et al., 2005; Yoerger et al., 2006). (Level of Evidence: C)

Class IIa

1. TTE studies performed every 1 to 2 years can be useful in the serial evaluation of symptomatically stable patients with HCM to assess the degree of myocardial hypertrophy, dynamic obstruction, and myocardial function (Klues, Schiffers, & Maron, 1995; Wigle et al., 1995; Afonso et al., 2008). (Level of Evidence: C)
2. Exercise TTE can be useful in the detection and quantiﬁcation of dynamic left ventricular outflow tract (LVOT) obstruction in the absence of resting outﬂow tract obstruction in patients with HCM (Maron et al., 2006; Maron MS et al., "Effect," 2003; Efthimiadis et al., 2009; Sorajja et al., 2009; Sherrid et al., 2005). (Level of Evidence: B)
3. TEE can be useful if TTE is inconclusive for clinical decision making about medical therapy and in situations such as planning for myectomy, exclusion of subaortic membrane or mitral regurgitation secondary to structural abnormalities of the mitral valve apparatus, or in assessment for the feasibility of alcohol septal ablation (Grigg et al., 1992; Marwick et al., 1992; Yu et al., 2000). (Level of Evidence: C)
4. TTE combined with the injection of an intravenous contrast agent is reasonable if the diagnosis of apical HCM or apical infarction or severity of hypertrophy is in doubt, particularly when other imaging modalities such as cardiovascular magnetic resonance (CMR) are not readily available, not diagnostic, or are contraindicated. (Level of Evidence: C)
5. Serial TTE studies are reasonable for clinically unaffected patients who have a ﬁrst-degree relative with HCM when genetic status is unknown. Such follow-up may be considered every 12 to 18 months for children or adolescents from high-risk families and every 5 years for adult family members (Bos, Towbin, & Ackerman, 2009; Maron, Seidman, & Seidman, 2004; Hershberger et al., 2009; Schwartz et al., 1996). (Level of Evidence: C)

Class III: NO BENEFIT

1. TTE studies should not be performed more frequently than every 12 months in patients with HCM when it is unlikely that any changes have occurred that would have an impact on clinical decision making. (Level of Evidence: C)
2. Routine TEE and/or contrast echocardiography is not recommended when TTE images are diagnostic of HCM and/or there is no suspicion of ﬁxed obstruction or intrinsic mitral valve pathology. (Level of Evidence: C)

Stress Testing

Class IIa

1. Treadmill exercise testing is reasonable to determine functional capacity and response to therapy in patients with HCM. (Level of Evidence: C)
2. Treadmill testing with monitoring of an ECG and blood pressure is reasonable for SCD risk stratiﬁcation in patients with HCM (Sadoul et al., 1997; Olivotto et al., 1999; Ciampi et al., 2002). (Level of Evidence: B)
3. In patients with HCM who do not have a resting peak instantaneous gradient of greater than or equal to 50 mm Hg, exercise echocardiography is reasonable for the detection and quantiﬁcation of exercise-induced dynamic LVOT obstruction (Maron et al., 2006; Frenneaux et al., 1990; Sadoul et al., 1997; Olivotto et al., 1999). (Level of Evidence: B)

Cardiac Magnetic Resonance

Class I

1. CMR imaging is indicated in patients with suspected HCM when echocardiography is inconclusive for diagnosis (Moon et al., 2004; Rickers et al., 2005). (Level of Evidence: B)
2. CMR imaging is indicated in patients with known HCM when additional information that may have an impact on management or decision making regarding invasive management, such as magnitude and distribution of hypertrophy or anatomy of the mitral valve apparatus or papillary muscles, is not adequately deﬁned with echocardiography (Maron MS et al., "Hypertrophic," 2009; Moon et al., 2004; Rickers et al., 2005; Maron MS et al., "Prevalence," 2008; Maron et al., 2010). (Level of Evidence: B)

Class IIa

1. CMR imaging is reasonable in patients with HCM to deﬁne apical hypertrophy and/or aneurysm if echocardiography is inconclusive (Moon et al., 2004; Maron MS et al., "Prevalence," 2008) (Level of Evidence: B)

Class IIb

1. In selected patients with known HCM, when SCD risk stratiﬁcation is inconclusive after documentation of the conventional risk factors (see Section 6.3.1 in the original guideline document), CMR imaging with assessment of late gadolinium enhancement (LGE) may be considered in resolving clinical decision making (Adabag et al., 2008; Maron MS et al., "Clinical," 2008; Rubinshtein et al., 2010; O'Hanlon et al., 2010; Moon et al., "Toward,"

2003). (Level of Evidence: C)
2. CMR imaging may be considered in patients with left ventricular (LV) hypertrophy and the suspicion of alternative diagnoses to HCM, including cardiac amyloidosis, Fabry disease, and genetic phenocopies such as LAMP2 cardiomyopathy (Gange, Link, & Maron, 2009; Maceira et al., 2005; Moon et al., "Gadolinium," 2003). (Level of Evidence: C)

Detection of Concomitant Coronary Disease

Class I

1. Coronary arteriography (invasive or computed tomographic imaging) is indicated in patients with HCM with chest discomfort who have an intermediate to high likelihood of coronary artery disease (CAD) when the identi¬cation of concomitant CAD will change management strategies. (Level of Evidence: C)

Class IIa

1. Assessment of coronary anatomy with computed tomographic angiography (CTA) is reasonable for patients with HCM with chest discomfort and a low likelihood of CAD to assess for possible concomitant CAD. (Level of Evidence: C)
2. Assessment of ischemia or perfusion abnormalities suggestive of CAD with single photon emission computed tomography (SPECT) or positron emission tomography (PET) myocardial perfusion imaging (MPI; because of excellent negative predictive value) is reasonable in patients with HCM with chest discomfort and a low likelihood of CAD to rule out possible concomitant CAD. (Level of Evidence: C)

Class III: NO BENEFIT

1. Routine SPECT MPI or stress echocardiography is not indicated for detection of "silent" CAD-related ischemia in patients with HCM who are asymptomatic. (Level of Evidence: C)
2. Assessment for the presence of blunted ï¬,ow reserve (microvascular ischemia) using quantitative myocardial blood ï¬,ow measurements by PET is not indicated for the assessment of prognosis in patients with HCM. (Level of Evidence: C)

Management of HCM

Asymptomatic Patients

Class I

1. For patients with HCM, it is recommended that comorbidities that may contribute to cardiovascular disease (e.g., hypertension, diabetes, hyperlipidemia, obesity) be treated in compliance with relevant existing guidelines (Redberg et al., 2009). (Level of Evidence: C)

Class IIa

1. Low-intensity aerobic exercise is reasonable as part of a healthy lifestyle for patients with HCM (Maron BJ et al., "American," 2003; Maron BJ et al., 2004). (Level of Evidence: C)

Class IIb

1. The usefulness of beta blockade and calcium channel blockers to alter clinical outcome is not well established for the management of asymptomatic patients with HCM with or without obstruction (Maron BJ et al., "American," 2003). (Level of Evidence: C)

Class III: HARM

1. Septal reduction therapy should not be performed for asymptomatic adult and pediatric patients with HCM with normal effort tolerance regardless of the severity of obstruction (Maron, 2002; Maron BJ et al., "American," 2003). (Level of Evidence: C)
2. In patients with HCM with resting or provocable outï¬,ow tract obstruction, regardless of symptom status, pure vasodilators and high-dose diuretics are potentially harmful (Braunwald et al., 1964; Maron, 2002). (Level of Evidence: C)

Symptomatic Patients

Pharmacologic Management

Class I

1. Beta-blocking drugs are recommended for the treatment of symptoms (angina or dyspnea) in adult patients with obstructive or nonobstructive HCM but should be used with caution in patients with sinus bradycardia or severe conduction disease (Braunwald et al., 1964; Maron, 2002; Maron BJ et al., "American," 2003; Spirito et al., 1997; Fifer & Vlahakes, 2008; Adelman et al., 1970; Cohen & Braunwald, 1967; Flamm, Harrison, & Hancock, 1968; Frank et al., 1978; Harrison et al., 1964; Stenson et al., 1973; Swanton et al., 1977; Wigle et al., 1974). (Level of Evidence: B)
2. If low doses of beta-blocking drugs are ineffective for controlling symptoms (angina or dyspnea) in patients with HCM, it is useful to titrate the dose to a resting heart rate of less than 60 to 65 bpm (up to generally accepted and recommended maximum doses of these drugs) (Braunwald et al., 1964;

Maron BJ et al., "American," 2003; Fifer & Vlahakes, 2008; Adelman et al., 1970; Cohen & Braunwald, 1967; Flamm, Harrison, & Hancock, 1968; Frank et al., 1978; Harrison et al., 1964; Stenson et al., 1973; Swanton, et al., 1977; Wigle et al., 1974). (Level of Evidence: B)

3. Verapamil therapy (starting in low doses and titrating up to 480 mg/d) is recommended for the treatment of symptoms (angina or dyspnea) in patients with obstructive or nonobstructive HCM who do not respond to beta-blocking drugs or who have side effects or contraindications to beta-blocking drugs. However, verapamil should be used with caution in patients with high gradients, advanced heart failure, or sinus bradycardia (Maron BJ et al., "American," 2003; Spirito et al., 1997; Fifer & Vlahakes, 2008; Bonow et al., 1981; Epstein & Rosing, 1981; Rosing et al., "Verapamil therapy: a new approach to the pharmacologic treatment of hypertrophic cardiomyopathy, II," 1979; Rosing, et al., "Verapamil therapy: a new approach to the pharmacologic treatment of hypertrophic cardiomyopathy, I," 1979; Rosing et al., 1981). (Level of Evidence: B)
4. Intravenous phenylephrine (or another pure vasoconstricting agent) is recommended for the treatment of acute hypotension in patients with obstructive HCM who do not respond to fluid administration (Fifer & Vlahakes, 2008; Braunwald & Ebert, 1962; Wigle et al., 1965; Haley et al., 1999). (Level of Evidence: B)

Class IIa

1. It is reasonable to combine disopyramide with a beta-blocking drug or verapamil in the treatment of symptoms (angina or dyspnea) in patients with obstructive HCM who do not respond to beta-blocking drugs or verapamil alone (Maron BJ et al., "American," 2003; Spirito et al., 1997; Fifer & Vlahakes, 2008; Kimball, Bui, & Wigle, 1993; Pollick et al., 1988; Pollick, 1988; Sherrid, Delia, & Dwyer, 1988). (Level of Evidence: B)
2. It is reasonable to add oral diuretics in patients with nonobstructive HCM when dyspnea persists despite the use of beta blockers or verapamil or their combination (Wigle et al., 1995; Spirito et al., 1997). (Level of Evidence: C)

Class IIb

1. Beta-blocking drugs might be useful in the treatment of symptoms (angina or dyspnea) in children or adolescents with HCM, but patients treated with these drugs should be monitored for side effects, including depression, fatigue, or impaired scholastic performance. (Level of Evidence: C)
2. It may be reasonable to add oral diuretics with caution to patients with obstructive HCM when congestive symptoms persist despite the use of beta blockers or verapamil or their combination (Maron BJ et al., "American," 2003; Spirito et al., 1997; Fifer & Vlahakes, 2008). (Level of Evidence: C)
3. The usefulness of angiotensin-converting enzyme inhibitors or angiotensin receptor blockers in the treatment of symptoms (angina or dyspnea) in patients with HCM with preserved systolic function is not well established, and these drugs should be used cautiously (if at all) in patients with resting or provocable LVOT obstruction. (Level of Evidence: C)
4. In patients with HCM who do not tolerate verapamil or in whom verapamil is contraindicated, diltiazem may be considered. (Level of Evidence: C)

Class III: HARM

1. Nifedipine or other dihydropyridine calcium channel-blocking drugs are potentially harmful for treatment of symptoms (angina or dyspnea) in patients with HCM who have resting or provocable LVOT obstruction. (Level of Evidence: C)
2. Verapamil is potentially harmful in patients with obstructive HCM in the setting of systemic hypotension or severe dyspnea at rest. (Level of Evidence: C)
3. Digitalis is potentially harmful in the treatment of dyspnea in patients with HCM and in the absence of AF (Braunwald et al., 1964; Maron BJ et al., "American," 2003; Fifer & Vlahakes, 2008; Adelman et al., 1970; Braunwald et al., 1961; Braunwald, Brockenbrough, & Frye, 1962; Sonnenblick et al., 1966). (Level of Evidence: B)
4. The use of disopyramide alone without beta blockers or verapamil is potentially harmful in the treatment of symptoms (angina or dyspnea) in patients with HCM with AF because disopyramide may enhance atrioventricular conduction and increase the ventricular rate during episodes of AF (Maron BJ et al., "American," 2003; Wigle et al., 1985; Spirito et al., 1997; Bergfeldt, Schenck-Gustafsson, & Dahlqvist, 1992; Birkhead & Vaughan Williams, 1977; Jensen & Uhrenholt, 1976; Lara, Oakley, & Rowbotham, 1980; Morady, Scheinman, & Desai, 1982; Robertson & Miller, 1980). (Level of Evidence: B)
5. Dopamine, dobutamine, norepinephrine, and other intravenous positive inotropic drugs are potentially harmful for the treatment of acute hypotension in patients with obstructive HCM (Braunwald et al., 1964; Elesber et al., 2008; Braunwald & Ebert, 1962; Wigle et al., 1965; Haley et al., 1999; Krasnow et al., 1963; Pierce, Morrow, & Braunwald, 1964; Whalen et al., 1963). (Level of Evidence: B)

Invasive Therapies

Class I

1. Septal reduction therapy should be performed only by experienced operators* in the context of a comprehensive HCM clinical program and only for the treatment of eligible patients with severe drug-refractory symptoms and LVOT obstruction.† (van der Lee, et al., 2008) (Level of Evidence: C)

*Experienced operators are deï¬ned as an individual operator with a cumulative case volume of at least 20 procedures or an individual operator who is working in a dedicated HCM program with a cumulative total of at least 50 procedures (see Section 6.2.2.3 in the original guideline document).

†Eligible patients are deï¬ned by all of the following:

a. Clinical: Severe dyspnea or chest pain (usually New York Heart Association [NYHA] functional classes III or IV) or occasionally other exertional symptoms (such as syncope or near syncope) that interfere with everyday activity or quality of life despite optimal medical therapy.
b. Hemodynamic: Dynamic LVOT gradient at rest or with physiologic provocation ≥50 mm Hg associated with septal hypertrophy and systolic anterior

motion (SAM) of the mitral valve.

c. Anatomic: Targeted anterior septal thickness suff¬cient to perform the procedure safely and effectively in the judgment of the individual operator.

Class IIa

1. Consultation with centers experienced in performing both surgical septal myectomy and alcohol septal ablation is reasonable when discussing treatment options for eligible patients with HCM with severe drug-refractory symptoms and LVOT obstruction. (Level of Evidence: C)
2. Surgical septal myectomy, when performed in experienced centers, can be beneï¬cial and is the ï¬rst consideration for the majority of eligible patients with HCM with severe drug-refractory symptoms and LVOT obstruction (Ommen et al., 2005; Sorajja et al., 2008; Woo et al., 2005; Firoozi et al., 2002; Ralph-Edwards et al., 2005; Smedira et al., 2008). (Level of Evidence: B)
3. Surgical septal myectomy, when performed at experienced centers, can be beneï¬cial in symptomatic children with HCM and severe resting obstruction (>50 mm Hg) for whom standard medical therapy has failed (Theodoro et al., 1996). (Level of Evidence: C)
4. When surgery is contraindicated or the risk is considered unacceptable because of serious comorbidities or advanced age, alcohol septal ablation, when performed in experienced centers, can be beneï¬cial in eligible adult patients with HCM with LVOT obstruction and severe drug-refractory symptoms (usually NYHA functional classes III or IV) (Sorajja et al., 2008; Fernandes et al., 2008; Gietzen et al., 2004; Kuhn et al., 2008; Kwon et al., 2008; Nagueh et al., 2001; Qin et al., 2001). (Level of Evidence: B)

Class IIb

1. Alcohol septal ablation, when performed in experienced centers, may be considered as an alternative to surgical myectomy for eligible adult patients with HCM with severe drug-refractory symptoms and LVOT obstruction when, after a balanced and thorough discussion, the patient expresses a preference for septal ablation (Fernandes et al., 2008; Firoozi et al., 2002; Kuhn et al., 2008; Nagueh et al., 2001; Qin et al., 2001). (Level of Evidence: B)
2. The effectiveness of alcohol septal ablation is uncertain in patients with HCM with marked (i.e., >30 mm) septal hypertrophy, and therefore the procedure is generally discouraged in such patients. (Level of Evidence: C)

Class III: HARM

1. Septal reduction therapy should not be done for adult patients with HCM who are asymptomatic with normal exercise tolerance or whose symptoms are controlled or minimized on optimal medical therapy. (Level of Evidence: C)
2. Septal reduction therapy should not be done unless performed as part of a program dedicated to the longitudinal and multidisciplinary care of patients with HCM. (Level of Evidence: C)
3. Mitral valve replacement for relief of LVOT obstruction should not be performed in patients with HCM in whom septal reduction therapy is an option. (Level of Evidence: C)
4. Alcohol septal ablation should not be done in patients with HCM with concomitant disease that independently warrants surgical correction (e.g., coronary artery bypass grafting for CAD, mitral valve repair for ruptured chordae) in whom surgical myectomy can be performed as part of the operation. (Level of Evidence: C)
5. Alcohol septal ablation should not be done in patients with HCM who are less than 21 years of age and is discouraged in adults less than 40 years of age if myectomy is a viable option.(Level of Evidence: C)

Pacing

Class IIa

1. In patients with HCM who have had a dual-chamber device implanted for non-HCM indications, it is reasonable to consider a trial of dual-chamber atrial-ventricular pacing (from the right ventricular apex) for the relief of symptoms attributable to LVOT obstruction (Erwin et al., 2000; Ommen et al., 1999; Slade et al., 1996; Gadler et al., 1999). (Level of Evidence: B)

Class IIb

1. Permanent pacing may be considered in medically refractory symptomatic patients with obstructive HCM who are suboptimal candidates for septal reduction therapy (Maron et al., 1999; Erwin et al., 2000; Ommen et al., 1999; Slade et al., 1996; Gadler et al., 1999). (Level of Evidence: B)

Class III: NO BENEFIT

1. Permanent pacemaker implantation for the purpose of reducing gradient should not be performed in patients with HCM who are asymptomatic or whose symptoms are medically controlled (Maron et al., 1999; Nishimura et al., 1997; Kappenberger et al., 1997). (Level of Evidence: C)
2. Permanent pacemaker implantation should not be performed as a ï¬rst-line therapy to relieve symptoms in medically refractory symptomatic patients with HCM and LVOT obstruction who are candidates for septal reduction (Maron et al., 1999; Nishimura et al., 1997; Kappenberger et al., 1997). (Level of Evidence: B)

Patients with LV Systolic Dysfunction

Class I

1. Patients with nonobstructive HCM who develop systolic dysfunction with an ejection fraction (EF) less than or equal to 50% should be treated according to evidence-based medical therapy for adults with other forms of heart failure with reduced EF, including angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, beta blockers, and other indicated drugs (Harris et al., 2006; Maron & Spirito, 1998). (Level of Evidence: B)
2. Other concomitant causes of systolic dysfunction (such as CAD) should be considered as potential contributors to systolic dysfunction in patients with HCM. (Level of Evidence: C)

Class IIb

1. ICD therapy may be considered in adult patients with advanced (as deï¬ned by NYHA functional class III or IV heart failure) nonobstructive HCM, on maximal medical therapy, and EF less than or equal to 50%, who do not otherwise have an indication for an ICD (Harris et al., 2006). (Level of Evidence: C)
2. For patients with HCM who develop systolic dysfunction, it may be reasonable to reassess the use of negative inotropic agents previously indicated, for example, verapamil, diltiazem, or disopyramide, and to consider discontinuing those therapies. (Level of Evidence: C)

Selection of Patients for Heart Transplantation

Class I

1. Patients with advanced heart failure (end stage*) and non-obstructive HCM not otherwise amenable to other treatment interventions, with EF less than or equal to 50% (or occasionally with preserved EF), should be considered for heart transplantation (Harris et al., 2006; Biagini et al., 2008). (Level of Evidence: B)
2. Symptomatic children with HCM with restrictive physiology who are not responsive to or appropriate candidates for other therapeutic interventions should be considered for heart transplantation (Gajarski et al., 2009; Towbin, 2002). (Level of Evidence: C)

*Characterized by systolic dysfunction (EF ≤50%), often associated with left ventricular (LV) remodeling, including cavity enlargement and wall thinning, and because of diffuse myocardial scarring.

Class III: HARM

1. Heart transplantation should not be performed in mildly symptomatic patients of any age with HCM. (Level of Evidence: C)

Prevention of SCD

SCD Risk Stratiï¬cation

Class I

1. All patients with HCM should undergo comprehensive SCD risk stratiï¬cation at initial evaluation to determine the presence of the following: (Elliott et al., 2000; Maron BJ, "Contemporary," 2010; Elliott et al., 2006; Maron et al., 1981; Maron, "Risk," 2010; Cecchi, Maron, & Epstein, 1989; Elliott et al., 1999; Fananapazir et al., 1992; Maki et al., 1998; McKenna et al., 1981; Spirito et al., 2009) (Level of Evidence: B):
    a. A personal history for ventricular ï¬brillation, sustained VT, or SCD events, including appropriate ICD therapy for ventricular tachyarrhythmias†
    b. A family history for SCD events, including appropriate ICD therapy for ventricular tachyarrhythmias†
    c. Unexplained syncope
    d. Documented non-sustained ventricular tachycardia (NSVT) deï¬ned as 3 or more beats at greater than or equal to 120 bpm on ambulatory (Holter) ECG
    e. Maximal LV wall thickness greater than or equal to 30 mm

†Appropriate ICD discharge is deï¬ned as ICD therapy triggered by VT or ventricular ï¬brillation, documented by stored intracardiac electrogram or cycle length data, in conjunction with the patient's symptoms immediately before and after device discharge.

Class IIa

1. It is reasonable to assess blood pressure response during exercise as part of SCD risk stratiï¬cation in patients with HCM (Sadoul et al., 1997; Elliot et al., 2006; Maki et al., 1998). (Level of Evidence: B)
2. SCD risk stratiï¬cation is reasonable on a periodic basis (every 12 to 24 months) for patients with HCM who have not undergone ICD implantation but would otherwise be eligible in the event that risk factors are identiï¬ed (12 to 24 months). (Level of Evidence: C)

Class IIb

1. The usefulness of the following potential SCD risk modiï¬ers is unclear but might be considered in selected patients with HCM for whom risk remains borderline after documentation of conventional risk factors:
    a. CMR imaging with LGE (Adabag et al., 2006; Moon et al., "Toward," 2003) (Level of Evidence: C)
    b. Double and compound mutations (i.e., >1) (Level of Evidence: C)
    c. Marked LVOT obstruction (Maron MS et al., "Effect," 2003; Elliott et al., 2006; Efthimiadis et al., 2009; Maki et al., 1998) (Level of Evidence: B)

Class III: HARM

1. Invasive electrophysiologic testing as routine SCD risk stratiﬁcation for patients with HCM should not be performed. (Level of Evidence: C)

Selection of Patients for ICDs

Class I

1. The decision to place an ICD in patients with HCM should include application of individual clinical judgment, as well as a thorough discussion of the strength of evidence, beneﬁts, and risks to allow the informed patient's active participation in decision making (see Figure 4 in the original guideline document) (Maron BJ, "Contemporary," 2010; Maron BJ et al., "Efficacy," 2000; Maron BJ et al., "Implantable," 2007; Maron & Spirito, 2008). (Level of Evidence: C)
2. ICD placement is recommended for patients with HCM with prior documented cardiac arrest, ventricular ﬁbrillation, or hemodynamically signiﬁcant VT (Maron BJ et al., "Implantable," 2007; Cecchi, Maron, & Epstein, 1989; Elliott et al., 1999; Fananapazir et al., 1992). (Level of Evidence: B)

Class IIa

1. It is reasonable to recommend an ICD for patients with HCM with:
    a. Sudden death presumably caused by HCM in 1 or more ﬁrst-degree relatives (Bos et al., 2010). (Level of Evidence: C)
    b. A maximum LV wall thickness greater than or equal to 30 mm (Elliott et al., 2000; Elliott et al., 2001; Spirito et al., 2000; Sorajja et al., 2006). (Level of Evidence: C)
    c. One or more recent, unexplained syncopal episodes (Spirito et al., 2009). (Level of Evidence: C)
2. An ICD can be useful in select patients with NSVT (particularly those <30 years of age) in the presence of other SCD risk factors or modiﬁers‡ (Maron BJ, "Contemporary," 2010; Monserrat et al., 2003). (Level of Evidence: C)
3. An ICD can be useful in select patients with HCM with an abnormal blood pressure response with exercise in the presence of other SCD risk factors or modiﬁers‡ (Sadoul et al., 1997; Olivotto et al., 1999; Maki et al., 1998). (Level of Evidence: C)
4. It is reasonable to recommend an ICD for high-risk children with HCM, based on unexplained syncope, massive LV hypertrophy, or family history of SCD, after taking into account the relatively high complication rate of long-term ICD implantation. (Level of Evidence: C)

‡SCD risk modiﬁers are discussed in Section 6.3.1.2 in the original guideline document.

Class IIb

1. The usefulness of an ICD is uncertain in patients with HCM with isolated bursts of NSVT when in the absence of any other SCD risk factors or modiﬁers‡ (Maron, 2010). (Level of Evidence: C)
2. The usefulness of an ICD is uncertain in patients with HCM with an abnormal blood pressure response with exercise when in the absence of any other SCD risk factors or modiﬁers,‡ particularly in the presence of signiﬁcant outﬂow obstruction (Sadoul et al., 1997; Olivotto et al., 1999; Maki et al., 1998). (Level of Evidence: C)

‡SCD risk modiﬁers are discussed in Section 6.3.1.2 in the original guideline document.

Class III: HARM

1. ICD placement as a routine strategy in patients with HCM without an indication of increased risk is potentially harmful. (Level of Evidence: C)
2. ICD placement as a strategy to permit patients with HCM to participate in competitive athletics is potentially harmful. (Level of Evidence: C)
3. ICD placement in patients who have an identiﬁed HCM genotype in the absence of clinical manifestations of HCM is potentially harmful. (Level of Evidence: C)

Selection of ICD Device Type

Class IIa

1. In patients with HCM who meet indications for ICD implantation, single-chamber devices are reasonable in younger patients without a need for atrial or ventricular pacing (Hauser et al., 2008; Boriani et al., 2004; Kleemann et al., 2007; Maisel et al., 2001). (Level of Evidence: B)
2. In patients with HCM who meet indications for ICD implantation, dual-chamber ICDs are reasonable for patients with sinus bradycardia and/or paroxysmal AF (Boriani et al., 2004). (Level of Evidence: C)
3. In patients with HCM who meet indications for ICD implantation, dual-chamber ICDs are reasonable for patients with elevated resting outﬂow gradients greater than 50 mm Hg and signiﬁcant heart failure symptoms who may beneﬁt from right ventricular pacing (most commonly, but not limited to, patients >65 years of age) (Maron et al., 1999; Nishimura et al., 1997; Kappenberger et al., 1997; Boriani et al., 2004). (Level of Evidence: B)

Participation in Competitive or Recreational Sports and Physical Activity

Class IIa

1. It is reasonable for patients with HCM to participate in low-intensity competitive sports (e.g., golf and bowling) (Maron et al., 2005; Pelliccia et al.,

2005). (Level of Evidence: C)
2. It is reasonable for patients with HCM to participate in a range of recreational sporting activities as outlined in Table 4 in the original guideline document (Maron et al., 2004). (Level of Evidence: C)

Class III: HARM

1. Patients with HCM should not participate in intense competitive sports regardless of age, sex, race, presence or absence of LVOT obstruction, prior septal reduction therapy, or implantation of a cardioverter-deï¬brillator for high-risk status (Maron, 2003; Maron BJ et al., "Sudden," 2009; Maron BJ et al., 2005; Pelliccia et al., 2005; Maron, Epstein, & Roberts, 1986; Maron BJ et al., "Relationship," 2003; Corrado et al., 2003). (Level of Evidence: C)

Management of AF

Class I

1. Anticoagulation with vitamin K antagonists (i.e., warfarin, to an international normalized ratio of 2.0 to 3.0) is indicated in patients with paroxysmal, persistent, or chronic AF and HCM (Olivotto et al., 2001; Fuster et al., 2011; Maron et al., 2002). (Anticoagulation with direct thrombin inhibitors [i.e., dabigatran§] may represent another option to reduce the risk of thromboembolic events, but data for patients with HCM are not available) (Connolly et al., 2009). (Level of Evidence: C)
2. Ventricular rate control in patients with HCM with AF is indicated for rapid ventricular rates and can require high doses of beta antagonists and non-dihydropyridine calcium channel blockers (Olivotto et al., 2001; Fuster et al., 2011). (Level of Evidence: C)

§Dabigatran should not be used in patients with prosthetic valves, hemodynamically signiï¬cant valve disease, advanced liver failure, or severe renal failure (creatinine clearance <15 mL/min [Connolly et al., 2009]).

Class IIa

1. Disopyramide (with ventricular rate–controlling agents) and amiodarone are reasonable antiarrhythmic agents for AF in patients with HCM (Fuster et al., 2011; Tendera et al., 1993). (Level of Evidence: B)
2. Radiofrequency ablation for AF can be beneï¬cial in patients with HCM who have refractory symptoms or who are unable to take antiarrhythmic drugs (Bunch et al., 2008; Gaita et al., 2007; Kilicaslan et al., 2006; Callans 2008; Di Donna et al., 2010). (Level of Evidence: B)
3. Maze procedure with closure of left atrial (LA) appendage is reasonable in patients with HCM with a history of AF, either during septal myectomy or as an isolated procedure in selected patients. (Level of Evidence: C)

Class IIb

1. Sotalol, dofetilide, and dronedarone might be considered alternative antiarrhythmic agents in patients with HCM, especially in those with an ICD, but clinical experience is limited. (Level of Evidence: C)

Other Issues

Pregnancy/Delivery

Class I

1. In women with HCM who are asymptomatic or whose symptoms are controlled with beta-blocking drugs, the drugs should be continued during pregnancy, but increased surveillance for fetal bradycardia or other complications is warranted (Bos, Towbin, & Ackerman, 2009; Hershberger et al., 2009; Bascou et al., 1993; Fitzgerald-Butt et al., 2010). (Level of Evidence: C)
2. For patients (mother or father) with HCM, genetic counseling is indicated before planned conception. (Level of Evidence: C)
3. In women with HCM and resting or provocable LVOT obstruction greater than or equal to 50 mm Hg and/or cardiac symptoms not controlled by medical therapy alone, pregnancy is associated with increased risk, and these patients should be referred to a high-risk obstetrician. (Level of Evidence: C)
4. The diagnosis of HCM among asymptomatic women is not considered a contraindication for pregnancy, but patients should be carefully evaluated in regard to the risk of pregnancy. (Level of Evidence: C)

Class IIa

1. For women with HCM whose symptoms are controlled (mild to moderate), pregnancy is reasonable, but expert maternal/fetal medical specialist care, including cardiovascular and prenatal monitoring, is advised. (Level of Evidence: C)

Class III: HARM

1. For women with advanced heart failure symptoms and HCM, pregnancy is associated with excess morbidity/mortality. (Level of Evidence: C)

Definitions:

Applying Classification of Recommendations and Level of Evidence

		Size of Treatment Effect					
		CLASS I *Benefit >>> Risk* Procedure/Treatment SHOULD be performed/ administered	CLASS IIa *Benefit >> Risk Additional studies with focused objectives needed* IT IS REASONABLE to perform procedure/administer treatment	CLASS IIb *Benefit ≥ Risk Additional studies with broad objectives needed; additional registry data would be helpful* Procedure/Treatment MAY BE CONSIDERED	CLASS III *No Benefit* or Class III *Harm*		
						Procedure/Test	Treatment
					COR III: No Benefit	Not helpful	No proven benefit
					COR III: Harm	Excess Cost without Benefit or Harmful	Harmful to Patients
Estimate of Certainty (Precision) of Treatment Effect	LEVEL A Multiple populations evaluated* Data derived from multiple randomized clinical trials or meta-analyses	• Recommendation that procedure or treatment is useful/effective • Sufficient evidence from multiple randomized trials or meta-analyses	• Recommendation in favor of treatment or procedure being useful/effective • Some conflicting evidence from multiple randomized trials or meta-analyses	• Recommendation's usefulness/efficacy less well established • Greater conflicting evidence from multiple randomized trials or meta-analyses	• Recommendation that procedure or treatment is not useful/effective and may be harmful • Sufficient evidence from multiple randomized trials or meta-analyses		
	LEVEL B Limited populations evaluated* Data derived from a single randomized clinical trials or nonrandomized studies	• Recommendation that procedure or treatment is useful/effective • Evidence from single randomized trial or nonrandomized studies	• Recommendation in favor of treatment or procedure being useful/effective • Some conflicting evidence from single randomized trial or nonrandomized studies	• Recommendation's usefulness/efficacy less well established • Greater conflicting evidence from single randomized trial or nonrandomized studies	• Recommendation that procedure or treatment is not useful/effective and may be harmful • Evidence from single randomized trial or nonrandomized studies		
	LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies or standard of care	• Recommendation that procedure or treatment is useful/effective • Only expert opinion, case studies, or standard of care	• Recommendation in favor of treatment or procedure being useful/effective • Only diverging expert opinion, case studies, or standard of care	• Recommendation's usefulness/efficacy less well established • Only diverging expert opinion, case studies, or standard of care	• Recommendation that procedure or treatment is not useful/effective and may be harmful • Only expert opinion, case studies, or standard of care		

A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the

guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as gender, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use. A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Even though randomized trials are not available, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

Clinical Algorithm(s)

The following algorithms are provided in the original guideline document:

- Treatment Algorithm
- Indications for ICDs in HCM
- Management of AF in HCM

Scope

Disease/Condition(s)

Hypertrophic cardiomyopathy

Guideline Category

Diagnosis

Evaluation

Management

Prevention

Risk Assessment

Treatment

Clinical Specialty

Cardiology

Family Practice

Internal Medicine

Preventive Medicine

Intended Users

Physicians

Guideline Objective(s)

To assist healthcare providers in clinical decision making by describing a range of generally acceptable approaches for the diagnosis, management, and prevention of specific diseases or conditions

Target Population

Adult and pediatric patients with hypertrophic cardiomyopathy

Interventions and Practices Considered

Diagnosis/Evaluation

1. Genetic testing and family screening for hypertrophic cardiomyopathy (HCM)
2. Electrocardiogram (ECG) (12 lead ECG, 24-hour ambulatory monitoring)
3. Echocardiography (transthoracic)
4. Stress testing
5. Cardiac magnetic resonance imaging
6. Coronary arteriography (invasive or computer tomographic)
7. Single photon emission computed tomography (SPECT) or positron emission tomography (PET) myocardial perfusion imaging
8. Sudden cardiac death (SCD) risk stratification

Management/Treatment

1. Management of comorbid conditions in asymptomatic patients
2. Pharmacological agents
    - Beta blockers
    - Verapamil (diltiazem if verapamil is contraindicated)
    - Intravenous phenylephrine
    - Disopyramide with a beta-blocking drug or verapamil
    - Oral diuretics
3. Invasive therapies
    - Septal reduction therapy
    - Surgical septal myectomy
    - Alcohol septal ablation
4. Pacing
5. Management of patients with left ventricular systolic dysfunction (angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, beta blockers, other indicated drugs, implantable cardioverter-defibrillator [ICD] in certain patients)
6. Selection of patients for heart transplantation
7. Selection of patients for ICD placement
8. Selection of ICD device type
9. Patient participation in sports or physical activity
10. Management of atrial fibrillation (AF)
    - Anticoagulation (vitamin K antagonists, thrombin inhibitors)
    - Beta antagonists and non-dihydropyridine calcium channel blockers for ventricular rate control
    - Disopyramide (with ventricular rate–controlling agents) and amiodarone (sotalol, dofetilide, dronedarone may be alternatives)
    - Radiofrequency ablation for AF
    - Maze procedure with closure of left atrial appendage
11. Management of pregnancy and delivery in women with HCM

Major Outcomes Considered

- Mortality
- Morbidity
- Risk of cardiac events
- Symptom control
- Adverse events associated with treatment

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

An extensive evidence review was conducted through January 2011. Searches were limited to studies, reviews, and other evidence conducted in human subjects and published in English. Key search words included, but were not limited to, hypertrophic cardiomyopathy (HCM), surgical myectomy, ablation, exercise, sudden cardiac death (SCD), athletes, dual-chamber pacing, left ventricular outï¬‚ow tract (LVOT) obstruction, alcohol septal ablation, automobile driving and implantable cardioverter-deï¬brillators (ICDs), catheter ablation, deï¬brillators, genetics, genotype, medical management, magnetic resonance imaging, pacing, permanent pacing, phenotype, pregnancy, risk stratiï¬cation, sudden death in athletes, surgical septal myectomy, and septal reduction. Additionally, the committee reviewed documents related to the subject matter previously published by the American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA).

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Applying Classification of Recommendations and Level of Evidence

<table>
<tr><td colspan="2"></td><td colspan="5">Size of Treatment Effect</td></tr>
<tr><td colspan="2" rowspan="3"></td><td rowspan="3">CLASS I

Benefit >>> Risk

Procedure/Treatment SHOULD be performed/ administered</td><td rowspan="3">CLASS IIa

Benefit >> Risk Additional studies with focused objectives needed

IT IS REASONABLE to perform procedure/administer treatment</td><td rowspan="3">CLASS IIb

Benefit ≥ Risk Additional studies with broad objectives needed; additional registry data would be helpful

Procedure/Treatment MAY BE CONSIDERED</td><td colspan="3">CLASS III No Benefit or Class III Harm</td></tr>
<tr><td></td><td>Procedure/Test</td><td>Treatment</td></tr>
<tr><td>COR III: No Benefit</td><td>Not helpful</td><td>No proven benefit</td></tr>
<tr><td rowspan="2">Estimate of Certainty (Precision) of Treatment Effect</td><td>LEVEL A

Multiple populations evaluated*

Data derived from multiple randomized clinical trials or meta-analyses</td><td>Recommendation that procedure or treatment is useful/effective
Sufficient evidence from multiple randomized trials or meta-analyses</td><td>Recommendation in favor of treatment or procedure being useful/effective
Some conflicting evidence from multiple randomized trials or meta-analyses</td><td>Recommendation's usefulness/efficacy less well established
Greater conflicting evidence from multiple randomized trials or meta-analyses</td><td>COR III: Harm</td><td>Excess Cost without Benefit or Harmful</td><td>Harmful to Patients</td></tr>
<tr><td colspan="3">Recommendation that procedure or treatment is not useful/effective and may be harmful
Sufficient evidence from multiple randomized trials or meta-analyses</td></tr>
<tr><td></td><td>LEVEL B

Limited populations evaluated*</td><td>Recommendation that procedure or treatment is useful/effective
Evidence from</td><td>Recommendation in favor of treatment or procedure being useful/effective</td><td>Recommendation's usefulness/efficacy less well established
Greater conflicting</td><td colspan="3">Recommendation that procedure or treatment is not useful/effective and may be harmful
Evidence from single randomized</td></tr>
</table>

		Size of Treatment Effect			
	Data derived from a single randomized clinical trials or nonrandomized studies	single randomized trial or nonrandomized studies	• Some conflicting evidence from single randomized trial or nonrandomized studies	evidence from single randomized trial or nonrandomized studies	trial or nonrandomized studies
	LEVEL C Very limited populations evaluated* Only consensus opinion of experts, case studies or standard of care	• Recommendation that procedure or treatment is useful/effective • Only expert opinion, case studies, or standard of care	• Recommendation in favor of treatment or procedure being useful/effective • Only diverging expert opinion, case studies, or standard of care	• Recommendation's usefulness/efficacy less well established • Only diverging expert opinion, case studies, or standard of care	• Recommendation that procedure or treatment is not useful/effective and may be harmful • Only expert opinion, case studies, or standard of care

A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as gender, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use. A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Even though randomized trials are not available, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

To provide clinicians with a comprehensive set of data, whenever deemed appropriate or when published, the absolute risk difference and number needed to treat or harm are provided in the guideline, along with confidence intervals and data related to the relative treatment effects, such as odds ratio, relative risk, hazard ratio, or incidence rate ratio.

In analyzing the data and developing the recommendations and supporting text, the writing committee used evidence based methodologies developed by the Task Force. The committee reviewed and ranked evidence supporting current recommendations with the weight of evidence ranked as Level A if the data were derived from multiple randomized clinical trials (RCTs) or meta-analyses. The committee ranked available evidence as Level B when data were derived from a single RCT or nonrandomized studies. Evidence was ranked as Level C when the primary source of the recommendation was consensus opinion, case studies, or standard of care. In the narrative portions of these guidelines, evidence is generally presented in chronological order of development. Studies are identified as observational, retrospective, prospective, or randomized when appropriate. For certain conditions for which inadequate data are available, recommendations are based on expert consensus and clinical experience and ranked as Level C. An example is the use of penicillin for pneumococcal pneumonia, for which there are no RCTs and treatment is based on clinical experience. When recommendations at Level C are supported by historical clinical data, appropriate references (including clinical reviews) are cited if available. For issues where sparse data are available, a survey of current practice among the clinicians on the writing committee was the basis for Level C recommendations and no references are cited. The schema for Classification of Recommendations and Level of Evidence is summarized in Table 1 (see the "Rating Scheme for the Strength of the Evidence" field), which also illustrates how the grading system provides an estimate of the size and the certainty of the treatment effect. A new addition to the ACCF/AHA methodology is separation of the Class III recommendations to delineate whether the recommendation is determined to be of "no benefit" or associated with "harm" to the patient. In addition, in view of the increasing number of comparative effectiveness studies, comparator verbs and suggested phrases for writing recommendations for the comparative effectiveness of one treatment/strategy with respect to another for Class of Recommendation I and IIa, Level of Evidence A or B only have been added.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

Experts in the subject under consideration have been selected from both organizations to examine subject-specific data and write guidelines in partnership with representatives from other medical practitioner and specialty groups. Writing committees are specifically charged to perform a formal literature review, weigh the strength of evidence for or against particular tests, treatments, or procedures, and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities, and issues of patient preference that may influence the choice of tests or therapies are considered. When available, information from studies on cost is considered, but data on efficacy and clinical outcomes constitute the primary basis for recommendations in these guidelines.

The recommendations listed in the original guideline document are, whenever possible, evidence based.

The committee was composed of physicians and cardiac surgeons with expertise in hypertrophic cardiomyopathy (HCM), invasive cardiology, non-invasive testing and imaging, pediatric cardiology, electrophysiology, and genetics. The committee included representatives from the American Association for Thoracic Surgery, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons.

Rating Scheme for the Strength of the Recommendations

See the "Rating Scheme for the Strength of the Evidence" field, above.

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

This document was reviewed by 2 outside reviewers nominated by both the American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA), as well as 2 reviewers each from the American Association for Thoracic Surgery, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons. Other content reviewers included members from the ACCF Adult Congenital and Pediatric Cardiology Council, ACCF Surgeons' Scientiﬁc Council, and ACCF Interventional Scientiﬁc Council. All information on reviewers' relationship with industry (RWI) was distributed to the writing committee and is published in this document (see Appendix 2 in the original guideline document).

This document was approved for publication by the governing bodies of the ACCF and the AHA and endorsed by the American Association for Thoracic Surgery, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Failure Society of America, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons.

Evidence Supporting the Recommendations

References Supporting the Recommendations

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Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

The recommendations listed in the original guideline document are, whenever possible, evidence based.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate and effective assessment and treatment of hypertrophic cardiomyopathy

Potential Harms

- Beta-blocking drugs should be used with caution in patients with sinus bradycardia or severe conduction disease.
- Verapamil should be used with caution in patients with high gradients, advanced heart failure, or sinus bradycardia.
- Angiotensin-converting enzyme inhibitors or angiotensin receptor blockers should be used cautiously (if at all) in patients with resting or provocable LVOT obstruction.
- Administration of beta-blocking drugs with either verapamil or diltiazem should also be performed with caution because of the potential for high-grade atrioventricular block.
- Class IC antiarrhythmic agents were associated with an increased mortality in patients with coronary artery disease. Thus, caution is advised when these agents are prescribed for patients with hypertrophic cardiomyopathy (HCM) and their use should probably be limited to individuals with an implantable cardioverter-defibrillator (ICD).
- Disopyramide may cause anticholinergic side effects that can be managed with dose reduction.
- Complications following myectomy are rare when performed in experienced centers. The risk of complete heart block is approximately 2% with myectomy (higher in patients with preexisting right bundle-branch block), but in myectomy patients who have had previous alcohol septal ablation, risk is much higher (50% to 85%). Iatrogenic ventricular septal defect occurs in <1% of patients. Finally, the risk of aortic valve or mitral valve injury is also low (<1%), particularly when myectomy is performed by an experienced operator.
- In approximately half of patients undergoing alcohol septal ablation, temporary complete atrioventricular block occurs during the procedure. Persistent complete heart block prompting implantation of a permanent pacemaker occurs in 10% to 20% of patients based on the available data. Approximately 5% of patients have sustained ventricular tachyarrhythmias during hospitalization. The in-hospital mortality rate is up to 2%. Because of the potential for creating a ventricular septal defect, septal ablation should not be performed if the target septal thickness is ≤15 mm.
- Potential early problems of ICD therapy in HCM may include pneumothorax, pericardial effusion, pocket hematoma, acute pocket infection, and/or lead dislodgment. Late complications include upper extremity deep venous thrombosis, lead dislodgment, infection, high defibrillation threshold necessitating lead revision, and inappropriate shocks, that is, shocks triggered by supraventricular arrhythmias, sinus tachycardia, lead fractures or dislodgment, oversensing, double counting, and programming malfunctions.

Contraindications

Contraindications

- Dihydropyridine class calcium channel blockers (e.g., nifedipine) should not be used in patients with obstructive physiology because their vasodilatory effects may aggravate outflow obstruction.
- Dabigatran should not be used in patients with prosthetic valves, hemodynamically significant valve disease, advanced liver failure, or severe renal failure (creatinine clearance <15 mL/min).

Qualifying Statements

Qualifying Statements

- The American College of Cardiology Foundation/American Heart Association (ACCF/AHA) practice guidelines are intended to assist healthcare providers in clinical decision making by describing a range of generally acceptable approaches for the diagnosis, management, and prevention of specific diseases or conditions. These practice guidelines represent a consensus of expert opinion after a thorough review of the available current scientiﬁc evidence and are intended to improve patient care. The guidelines attempt to deﬁne practices that meet the needs of most patients in most circumstances. The ultimate judgment regarding care of a particular patient must be made by the healthcare provider and patient in light of all the circumstances presented by that patient. Thus, there are situations in which deviations from these guidelines may be appropriate. Clinical decision making should consider the quality and availability of expertise in the area where care is provided. When these guidelines are used as the basis for regulatory or payer decisions, the goal should be improvement in quality of care. The Task Force recognizes that situations arise for which additional data are needed to better inform patient care; these areas will be identiﬁed within each respective guideline when appropriate.
- Prescribed courses of treatment in accordance with these recommendations are effective only if they are followed. Because lack of patient understanding and adherence may adversely affect outcomes, physicians and other healthcare providers should make every effort to engage the patient's active participation in prescribed medical regimens and lifestyles.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Clinical Algorithm

Pocket Guide/Reference Cards

Quick Reference Guides/Physician Guides

Slide Presentation

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Living with Illness

Staying Healthy

IOM Domain

Effectiveness

Patient-centeredness

Identifying Information and Availability

Bibliographic Source(s)

Gersh BJ, Maron BJ, Bonow RO, Dearani JA, Fifer MA, Link MS, Naidu SS, Nishimura RA, Ommen SR, Rakowski H, Seidman CE, Towbin JA, Udelson JE, Yancy CW. 2011 ACCF/AHA guideline for the diagnosis and treatment of hypertrophic cardiomyopathy: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2011 Dec 13;58(25):e212-60. [453 references] PubMed

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Financial Disclosures/Conflicts of Interest

The Task Force makes every effort to avoid actual, potential, or perceived conflicts of interest that may arise as a result of relationships with industry and other entities (RWI) among the writing committee. Specifically, all members of the writing committee, as well as peer reviewers of the document, are required to disclose all relevant relationships and those 12 months prior to initiation of the writing effort. The policies and procedures for RWI for this guideline were those in effect at the initial meeting of this committee (March 28, 2009), which included 50% of the writing committee with no relevant RWI. All guideline recommendations require a confidential vote by the writing committee and must be approved by a consensus of the members voting. Members who were recused from voting are indicated on the title page of this document with detailed information included in Appendix 1 in the original guideline document. Members must recuse themselves from voting on any recommendations where their RWI apply. If a writing committee member develops a new RWI during his/her tenure, he/she is required to notify guideline staff in writing. These statements are reviewed by the Task Force and all members during each conference call and/or meeting of the writing committee and are updated as changes occur. For detailed information regarding guideline policies and procedures, please refer to the ACCF/AHA methodology and policies manual. RWI pertinent to this guideline for authors and peer reviewers are disclosed in Appendixes 1 and 2 in the original guideline document, respectively.

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) from the American College of Cardiology Web site and the Circulation Web site.

Print copies: Available from the ACC, 2400 N Street NW, Washington DC, 20037; (800) 253-4636 (US only).

Availability of Companion Documents

The following are available:

- Gersh BJ, Maron BJ, et al. 2011 ACCF/AHA guideline for the diagnosis and treatment of hypertrophic cardiomyopathy: executive summary. Bethesda (MD): American College of Cardiology/American Heart Association. 2011 Dec. 38 p. Electronic copies: Available in Portable Document Format (PDF) from the Journal of the American College of Cardiology (JACC) Web site .
- ACCF/AHA pocket guideline. Guideline for the diagnosis and treatment of hypertrophic cardiomyopathy. Bethesda (MD): American College of Cardiology/American Heart Association. 2011 Nov. 42 p. Electronic copies: Available in PDF from the JACC Web site .
- 2011 ACCF/AHA guideline for the diagnosis and treatment of hypertrophic cardiomyopathy. Slide set. Bethesda (MD): American College of Cardiology/American Heart Association. 2011. 74 p. Electronic copies: Available from the JACC Web site .
- Methodology manual and policies from the ACCF/AHA Task Force on Practice Guidelines. 2010 Jun. 88 p. American College of Cardiology Foundation and American Heart Association, Inc. Electronic copies: Available in PDF from the American College of Cardiology (ACC) Web site .

Print copies: Available from the ACC, 2400 N Street NW, Washington DC, 20037; (800) 253-4636 (US only).

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on April 18, 2012. The information was verified by the guideline developer on May 16, 2012. This summary was updated by ECRI Institute on January 23, 2013 following the U.S. Food and Drug Administration advisory on Pradaxa (dabigatran etexilate mesylate).

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